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PSEUDOMASARIS VESPOIDES (CRESSON), A POLLEN PROVISIONING WASP

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A first account of the habits of *Pseudomasaris vespoides* has been given by Dr. A. Davidson ('13). He found their nests, usually attached to a twig of a low bush, and built after the manner of the mud dauber wasp but of stony hardness. The completed cell was closed by a stopper of clay which was depressed in the center so that the top of the nest presented a series of small cups. The cup was believed to conserve the rain, soften the stopper and enable the insect to more easily emerge. The cells were thought to have been stored with small larvae. According to Bradley ('22), *P. vespoides* is found in South Dakota, Idaho, Colorado, New Mexico, Utah, Nevada and California.

Masarid wasps are of chief interest because of the fact that they provision their nest with pollen and honey, thus differing from other solitary wasps using animal food. Very little is known of the habits of the different species but the observed facts point to food habits similar to those of solitary bees.

Comstock ('25), in reviewing the facts known in regard to the habits of these wasps, reports, in addition to *P. vespoides*, those of two studied in France. The three species, *P. vespoides* in the United States, *Ceramius lusitanicus* and *Celonitis abbreviatus* in Europe, constitute the only forms whose habits have been reported from this very interesting group of wasps.

The habits of *Ceramius lusitanicus*, reported from Comstock, were described by Giraud ('71). This wasp digs a burrow in the ground, leading to the cell in which the larva lives. The larva is fed by the mother on a paste something like honey, which she brings from time to time, thus engaging in progressive provisioning. The other European species, *Celonitis abbreviatus*, the habits of which were described by Ferton ('10), uses pollen and honey to feed the larvae which live in earthen cells on the sides of rocks or in the stems of plants.

All the nests of *P. vespoides* found here have been attached to rocks; those found by Dr. Davidson in California were attached either to rocks or twigs. The following is a partial account of my studies of this species.

A nest of *P. vespoides*, consisting of 13 cells, was found on February 12, 1926, attached to the south side of a large rock, along a railroad east of Boulder. The cells were made of very fine soil and mixed with something, which upon drying made a very hard, gray mass. The nest was 100 mm. wide and one cell long, all the tops of which were in a straight line. The length of the cells measured from 20 to 30 mm., those on the ends being somewhat shorter than the cells in the center. All had a cup-shaped depression at the top.

The larvae were taken from the vertical cells at the time found, and the content of each cell noted. Beginning at one side we have the following record: 2 empty cells; dead larva; live larva; pollen mass; 3 live larvae; dead larva; live

larva; and finally 3 empty cells. The dead larvae found in the cells were both quite large and appeared as a lump of fatty tissue. All the cells were complete, the empty, as well as the others, having a cap securely constructed with the depression at the top.

The larvae were white and exceedingly soft bodied so that when lying on a smooth surface the body would tend to flatten. When found in the cell, the larva is usually well to the upper end, the posterior part of the body some distance from the base of the cell and not serving as a support. Somewhat below the middle of the length of the body, the sides bulged out and came in contact with the inner surface of the sides of the cell. It was this contact which held the larva in place. The space found below each larva was partly filled with a compact, cup-shaped mass of excrement in the very bottom of the cell. All the larvae had the head inverted and invisible because of the anterior segments folding over and downward and concealing all trace of it. The head could be found by gently raising the anterior segments which concealed it and could be found pressed against the ventral surface of the body. Just previous to pupation the head is gradually raised until it is entirely erect.

In removing the larvae from the cells the extreme hardness of the walls and the soft body of the insect were in sharp contrast. Two were injured and were found to consist largely of a watery liquid and fat, which ran out leaving a limp skin. The interior of the cell, containing a mature larva, is quite smooth and covered with a light, brownish, silky lining representing the cocoon. The empty cells in this series contained no silken lining, thus showing that they had not been used.

Three larvae were brought to the laboratory and placed each in a small vial having a diameter of about the same size as that of the cell. Cotton stoppers were placed in the ends of the vials and the larvae kept at room temperature during the rest of their development. These vials were kept upright with the larvae in a natural position. Subsequent rearing showed this latter precaution to be unnecessary.

One larva died soon after bringing it to the laboratory, having been injured in taking it from the cell; the other two pupated March 20, reaching maturity 20 days later. The pupae are at first white, becoming darker as maturity approaches. The sexes can be distinguished at the time of pupation by the differences in shape and size of the antennae, shape of abdomen, and the like. The pupae of *P. vespoides* remain nearly motionless when disturbed and in this agree with observations of bee pupae of *Anthophora neomexicana* Ckll, they differ from those of *Pseudomelecta miranda* Fox and the mordellid beetle (*Mordellistena* sp.)* reared from the old stems of the weed, *Iva xanthifolia*, which move the abdomen very energetically when stimulated. These reactions were noted at a very early date after pupation and were found to continue to maturity.

Three or four days before reaching maturity the pupal skin of *P. vespoides* is cast. The wings are at first almost colorless, gradually becoming darker and the nervures more distinct in outline. The length of pupal life from reared specimens has been, on an average, 20 days. The date of maturity has been considered the time after the casting of pupal skin when the insect becomes normally

*—Determined by Mr. H. S. Barber.

active. The wings are at first very moist and tend to stick to the sides of the vial. To avoid injury from this, newly emerged wasps were transferred to a larger test tube.

It has previously been supposed that *P. vespoides* uses insect larvae to feed its young. This food habit has been contrasted by Comstock ('25) with masarid wasps of Europe which supply pollen and honey for their young. Early in the spring of 1926 I found evidence at Boulder which pointed to the fact that *P. vespoides* does store pollen. It was at first thought that the insect Dr. Davidson studied in California and the one reared and studied here might belong to different species. Much time was spent in a study of the structure of specimens collected in Colorado, New Mexico and California. In the end the conclusion was reached that *P. vespoides,* although a very distinct and good species, is subject perhaps to some minor variations and that the specimens taken in California are very like those collected here.

In the summer of 1926 a trip was made to California in order to see Dr. Davidson and study the species there. In a conversation with him and also in a letter written in December, Dr. Davidson stated that he does not know what the insect feeds to its young not having taken a nest early enough to learn what was stored in the cells. He early believed it used animal food because of the fact that little residue was left in the cell.

Uneaten pollen has been found in three different nests of *P. vespoides.* From one a large mass, representing doubtless the amount necessary for the development of one insect, was taken; from a second a dead half-grown larva and a considerable amount of pollen was secured; and in a third a small quantity of pollen had been left which the young had not consumed.

The mass of pollen probably represents mass provisioning since the amount, in the first instance, was about that which one wasp would need for its development. More conclusive evidence is presented in the case of the half-grown, dead larva found on a similar mass of about half the size. Both these cells were sealed with a plug 4 mm. thick; the wasp probably having stocked each cell with sufficient pollen for the growth of one insect, laid the egg and then closed the opening to the outside.

The mass of pollen, which had not been partly eaten, measured 12 mm. in length, nearly 5 mm. in width and was about 2 mm. thick. In form the mass resembled somewhat the pollen found in the stems provisioned by the rather primitive bees of the genus *Ceratina* and of the genus *Hylaeus.* The pollen was dark brown and hard, when taken from the cell. This cell had no cocoon and was just as it had been left by the female after provisioning. The most peculiar thing about the pollen mass was the covering of small, scale-like or cone-shaped projections over the entire surface. The number of these elevations or papillae were estimated to be about 250. They appeared quite regular and uniform in size, consisting of a broad, round base drawn out to a point which varied from blunt to sharp. They were probably separate deposits of pollen which the wasp had swallowed on collecting and had later placed in the cell. The method of collecting and storing pollen is offered merely as a suggestion resulting from a study of the cell content and wasp structure and needs field observation and verification. Since these de-

posits kept their shape the pollen collected must have been fairly sticky. Chemical analysis, made by Mr. W. W. Bacon of the Denison Research Laboratories, show the reducing sugars after hydrolization to be 15.42 per cent of the mass by weight. Miss Maxy Pope has kindly determined the pollen to have been from some member of Compositae.

Still further evidence that *P. vespoides* feeds its young on pollen is found upon microscopical examination of the excrement of the larvae. Some of the hard, dry excrement from the bottom of the cell was moistened until it would spread evenly and thinly on a slide, then examined under the high power of the microscope. Each smear showed many somewhat shrivelled pollen grains. This was true of the material examined from all the cells. Similar study of the excrement from the cells of a number of species of bees, *Lithurgus apicalis, Megachile montivaga, Dianthidium sayi, D. pudicum, Alcidamea hypocrita, A. producta* and others, were made and in each instance the feces were found to consist mainly of pollen grains. Pollen grains from the feces of reared specimens of *Nomia triangulifera* Vachal., not subjected to the somewhat destructive field conditions, were found in nearly perfect condition. The question arises as to the manner in which nutriment is obtained by the larvae from pollen grains. It was thought that it might be secured through the walls, or in some cases, breaks in the grains might allow digestion of the material within.

On May 8, 1926 a group of 5 cells, found by Mrs. Hicks, were taken from the side of a rock at East Boulder. Two were empty; the other three contained cocoons filling but 10 mm. of the space within. Above, between the top of the cocoon and the bottom of the plug, was an empty space of 7 mm.; below the cocoon, a space of 3 mm. was filled with excrement. The cocoons filled the entire diameter of the cell and rested near the bottom. Some studied later were found nearer the top. The clay colored cocoon was, in every case, extremely flat across the top, being rather thin in the center, thicker and with some glassy fibers at the edges. The center was parchment-like and an insect could be seen indistinctly within. Upon opening one of the cocoons, a nearly mature chrysis, of the late pupal stage was found. The cocoon of *P. vespoides* was also found in these cells, that of the chrysis having been constructed last.

Other nests have been found, some of the cells of which contained the larvae of *P. vespoides* and the cocoons of the chrysis parasite. The adult chrysis is able to chew through the dry, hard cap, having been observed to do so in the laboratory. Mr. S. A. Rohwer has kindly determined the parasite as *Chrysis* (*Gonochrysis*) *densa* (Cress.). This species has recently (Hicks '26) been reported to be a common parasite of a bee, *Osmia mandibularis* Cress. This parasite was determined by Professor T. D. A. Cockerell. Another parasite, from cells of *O. mandibularis*, has since been determined by Mr. Rohwer as a new species, near *Chrysis tota* Aaron. An insect, which may be *C. densa*, is also found parasitic on *P. vespoides* in California.

The cavities of old cells of *P. vespoides* are readily used as nesting sites here, by certain bees of the genus *Megachile, Anthidiellum*, and *Anthidium;* in California Dr. Davidson states that they are not infrequently occupied by secondary wasps and bees. In the examination of excrement from the cells of *P. vespoides*

care was taken not to confuse it with that from any other insect. The excrement of the wasp is placed in the very bottom of the cell while that of the bees mentioned above is found about the cocoon; between it and the leaves or petals in the case of *Megachile* bees; between the cocoon and the resin in the instances of use by *Anthidiellum;* and between the cocoon and the cell of down when appropriated by *Anthidium*. When the wasp larva has been killed by the parasitic chrysis the excrement is still found at the base of the cell and contains pollen grains. These grains have doubtless passed through the digestive tract of the young wasp larva before its life was cut short by the parasite.

The number of cells to the nest varies from 2 to 13, the average of 8 nests being 6.4. Of 40 cells examined from 7 nests, 13 were found empty (sealed but never provisioned), 5 contained the parasitic chrysis, 9 were used by bees, while 13 contained larvae of *P. vespoides*, 2 of which had died in an early larval stage.

A male, *Megachile perbrevis* Cress., has just been reared from one old nest of this wasp and a male *Dianthidium*, which appears to be new, from another.

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DESCRIPTIONS OF NEARTIC DIPTERA.*

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The types of the new species herein described will be found in the Canadian National Collection. Many of them have been collected by workers in Western Canada through whose efforts very many species not previously represented on the National Collection have been secured and to whom we are greatly indebted.

MYCETOPHILIDAE

Gnoriste macroides n. sp.

Similar to *G. macra* Joh. but the lateral lobe of the forceps is entire instead of being inequally forked. Length 8 mm.

Male. Black, the legs and halteres yellowish, the hair long, shining yellowish. Head thinly brownish yellow pollinose, the front bare or nearly so, the face and proboscis with very short hair. Proboscis as long as head and thorax together (2 mm.). Antennae brown, the incisure between the second and third segments broadly reddish.

Mesonotum shining black, thinly gray pollinose laterally, where the hair is coarse, that at the sides bristly, with two posteriorly converging dorsal vittae and an anterior single row of finer hairs; scutellum with apical row of six or

*—Contribution from the Division of Systematic Entomology, Entomological Branch, Dept. of Agric., Ottawa.

eight horizontal bristles and some short, fine hairs. Lateral margin of mesonotum narrowly, its sutures and the anterior spiracle, yellowish.

Posterior coxae with about half of outer surface stained with brown, the trochanters and tarsi brown. Hair of coxae and femora yellowish, elsewhere black; apical spines reddish; bristles black.

Abdomen thinly brownish gray pollinose, the apices of the second to fourth segments more or less reddish laterally. Forceps brownish red, the lateral lobe brown.

Holotype—♂, Orillia, Ont., June 5, 1925, (Curran); No. 2365 in the Canadian National Collection, Ottawa.

Paratype—♂, Aylmer, Que., June 15, 1924, (Curran).

Mycetophila alberta n. sp.

Brownish black, the palpi and basal two antennal segments reddish; halteres and legs yellow. Length 3 mm.

Female. Head brownish gray pollinose, the hair brownish yellow. Thorax with brownish yellow hair and black setae. Scutellum with four bristles. Mesopleura setulose on upper half. Tarsi with brownish tinge, the anterior pair brownish, second and third segment of front tarsi broadened and considerably thickened below, the fourth scarcely so; first segment of front tarsus four-fifths as long as tibia; middle tibia with three ventral bristles; hind tibiae with two ranges of bristles; posterior femora brown on apical fourth with a row of bristly hairs on the apical fourth of the antero-ventral surface. Wings hyaline, with a small brown spot on the crossveins and a paler one before the end of the second vein, spreading well behind the vein. The media and cubitus fork almost behind the crossvein. Hair of abdomen yellowish, genitalia reddish.

Holotype—♀, Edmonton, Alta., May 5, 1925, (E. H. Strickland); No. 2417 in the Canadian National Collection, Ottawa.

BIBIONIDAE

Bibio carri n. sp.

Related to *abbreviatus* Loew but the posterior femora and tibiae are much stronger, coxae black, anterior spur of front tibiae only slightly over half as long as the posterior, etc. Length 6.5 mm., of wing 5 mm.

Female. Black, cinereous haired, legs largely reddish. Antennae 8-segmented, brownish pubescent, the front with only a few scattered hairs, finely granulate except the orbits and front border, without tubercles, hair of eyes rather sparse. Outer two-thirds of collar brownish red; mesonotum finely granulate except broad median and lateral vittae, somewhat strigulose, the hair short, rather yellowish. Femora reddish with the apex rather broadly black, unusually swollen; tibiae reddish with the broad base and apex blackish, the anterior ones with brownish stains near the middle posteriorly, all more robust than usual, the posterior pair short; tarsi black, the basal two-thirds of first and one third of second segment, yellowish red, the hair on the tarsi above mostly black. Wings cinereous hyaline, the veins luteous on basal half, brown apically, all strong; stigma small, oval. Squamae brown, with pale fringe. Halteres wholly brown. Abdomen short and robust with short, rather sparse, sub-appressed pile. Basal segment of posterior tarsus shorter than following three combined.

Holotype—♀, Medicine Hat, Alta., April 24, 1926, (F. S. Carr); No. 2333 in the Canadian National Collection, Ottawa.

Paratype—♀, same data, in Mr. Carr's collection.

TABANIDAE

Tabanus cristatus n. sp.

(Figs. 1-3)

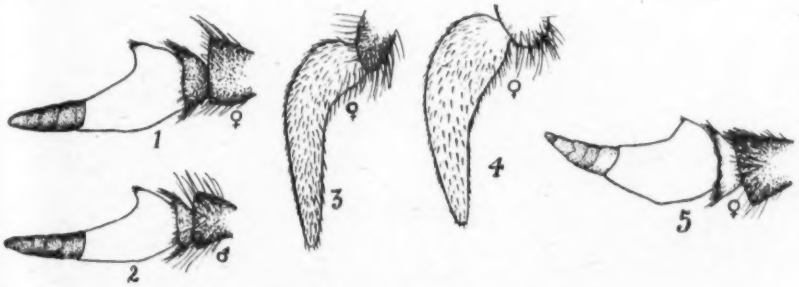
Related to *montanus* Meigen but at once distinguished by the large dorso-median patches of erect, black pile on the second to fourth segments in the male and the narrower, darker palpi in the female. Length, 14 to 15 mm.

Male. General color as in *epistates* O. S. Head cinereous pollinose and pilose, the eyes with reddish yellow pile; vertical triangle black haired, the palpi and upper part of face with some scattered black hair. Basal palpal segment black, at most its apex yellow. Antennae black, the third segment reddish except the stylate portion, strongly angled and slightly produced above; basal segment with pale pile basally.

Mesonotum bluish black with five obscure grayish vittae, the median one linear, the median third thinly pollinose in some views; pleura conspicuously gray pollinose. Dorsum and mesopleura black haired; the anterior border, sides narrowly behind, some scattered hairs in front and the pleura with very fine cinereous pile, the scutellum almost wholly pale haired on apical half.

Legs black; tips of femora pale reddish yellow; basal fourth of front and half of posterior four tibiae brownish red. Hair of legs almost all black; pale on the posterior four femora basally and their tibiae beneath on basal fourth.

Wings cinereous hyaline, the veins clouded with brownish except the posterior ones. Branch of third vein normally without appendage, although usually angulated.



T. cristatus n. sp.: 1. ♀ antenna; 2. ♂ antenna; 3. ♀ palpus.
T. montanus Meigen: 4. ♀ palpus; 5. ♀ antenna.

First abdominal segment black with broad posterior border on the lateral third reddish. Second and third segments each reddish, with a large rectangular or sub-rectangular black median spot which is separated from the apex of the segment; that on the third segment not reaching the base and somewhat convex in front. Fourth segment often like the third but with a longitudinal black lateral spot and sometimes a narrow pre-apical blackish fascia, rarely almost all black, following segments black; all the segments with the posterior margin pale reddish yellow and with pale pile; hair elsewhere black. The black spot of the second segment is divided by a broad, thinly grayish pollinose vitta, while in some

views there is a broad, sub-lateral, pale pollinose vitta which is quite obsolete from dorsal view. The hair on the black rectangles is very dense, coarse and erect, that on the second segment divided in the middle; the sides of the abdomen bear very conspicuous black hair, the pale hair being limited entirely to the pale segmental apices. The first two ventral segments are black in the middle, while the following two are wholly reddish, the others black with pale apices. The pile is appressed and yellowish, the apical three sternites and a broad median vitta extending forward onto the second sternite, black haired.

Female. Apical palpal segment long and narrow, dark reddish yellow, with appressed black hair. The third antennal segment is wide and is distinctly produced above at the angle. Front moderately narrow, gently widening to above the middle; callous shining black; not reaching the sides, slightly transverse, gently convex above where it emits a rather broad black vitta which extends half way to the shining brownish, slightly swollen ocelligerous tubercle. The scutellum bears less pale pile while the anterior branch of the third vein is evidently more often appendiculate. The second to fourth abdominal segments each bear a grayish posterior triangle in the middle which does not reach the base, while only the second and third are reddish, the third with a lateral black spot in front. The pile is not conspicuously tufted although it is somewat longer than usual on the middle of the second to fourth segments. The second, third and fourth sternites each bear a broad lateral dark spot while the fourth has the posterior border and a large median triangle which extends onto the third segment black. The black pile is limited to the apical three sternites.

Holotype—♂, Nordegg, Alta., July 11, 1914, (J. McDunnough); No. 2360 in the Canadian National Collection, Ottawa.

Allotype—♀, Labrador.

Paratypes—3♂, Nordegg, July 11 and 14, (McDunnough).

Tabanus montanus Meigen.

(Figs. 4, 5)

Syst. Beschr., ii, 55, 1820.

The Canadian National Collection contains a male and two females from Europe, determined by Dr. Krőber.

Tabanus canadensis n. sp.

Belongs to the *septentrionalis* group from all of which it is distinguished by its small size and shape of the palpi. Distinguished from *septentrionalis* Lw. by the grayish yellow abdominal pollen and the almost entire absence of black hair on the posterior femora. Black with reddish markings. Length 12 to 13.5 mm.

Female. Head gray pollinose, the front with luteous tinge above; frontal callous shining black, transverse, convex above; a rather broad median black vitta above it, the ocellar tubercle reddish brown; front rather wide, gently widening to the vertex. Hair of head whitish, very fine, face with a very few coarse black hairs, the front with coarse black hair on upper half. Palpi light yellowish, with chiefly black hairs, although at times the pale ones predominate, in shape, moderately robust, shorter and broader than in allied species. Antennae black, the third segment broadly reddish basally, the second and often the first segment

reddish, gray pollinose. Third segment with scarcely any angle, its style not as long as the basal section.

Thorax grayish pollinose, with four rather indistinct darker vittae. The mesonotum and border of the scutellum bear sparse tomentum-like golden yellow pile and sparse, coarse black hairs, which predominate on the notopleura and most of the mesopleura, the pleura whitish pilose.

Femora and tarsi black; apices of the femora and the tibiae reddish; anterior tibiae brown on about the apical half, the broad apices of the other tibiae reddish brown, the posterior tarsi brownish red basally. Hair of middle and posterior femora practically all pale, at most a very few black hairs, the front ones with pale hair behind; hair on tibiae mostly black, pale on basal two thirds or less of the anterior and posterior surface but usually mixed with black on most of the tibiae; wholly black on the tarsi.

Wings cinereous hyaline, the veins brown, usually somewhat luteous basally. Abdomen with the sides of the second and third segments or the second to fourth, often broadly reddish; with three rows of grayish yellow pollinose spots, the median row composed of longitudinal triangles forming a complete vitta, the outer rows of spots resting on the bases of the segments and somewhat oblique, the apices of the segments narrowly pale pollinose. Venter wholly pale pollinose, the black pile limited to the two apical sternites.

Holotype—♀, Winnipegosis, Man., July 13, 1926, (G. S. Brooks); No. 2368 in the Canadian National Collection, Ottawa.

Paratypes—3♀, same data; ♀, Westbourne, Man., Aug. 24, 1924; 2♀, Hussavick, Man., Aug. 6, 1914 and July 11, 1923, (J. B. Wallis); 3♀, Cypress Hills, Alta., July 29, 1925, and July 22, 1926, (F. S. Carr).

This species has been confused with *septentrionalis* Loew but is readily distinguished by its colour, and in addition the segments of the front tarsi are longer. *T. septentrionalis* is known to me only with certainty from Labrador and it has a broad median band of black pile on the abdominal venter. In specimens from Arctic Canada otherwise like *septentrionalis* this band is absent and the specimens probably represent a distinct species.

There are two described species with very similar coloration to *canadensis; frontalis* Walker, which has longer, more strongly narrowed palpi and wholly pale pilose mesopleura and *incisus* Walker which is close to *frontalis* but has the mesopleura black pilose. These names may apply to the same species although it seems doubtful since there are quite evidently two or three closely related species associated here.

Tabanus labradorensis Enderlein.

Tylostypia labradorensis End., Mitt. Zool. Mus. Berlin, xi, 363, 1925.

This species is very close to *septentrionalis* Loew although neither species is constant in the character of an appendage on the anterior branch of the third vein. This appendage is usually present in *labradorensis*, seldom so in *septentrionalis*. In *labradorensis* the abdominal venter bears coarse black hairs only on the apical two or three sternites, while the third antennal segment is hardly as wide.

Specimens in the collection are from: Labrador, East Coast James Bay, Quebec, Northwest Territories (Crickmay) and Yukon Territory.

BOMBYLIIDAE

Anthrax plesia n. sp.

Very similar to *A. pauper* Lw. but at once distinguished by the black supra-squamal tuft. Black, with grayish, white and black vestiture. Length, 8 to 11.5 mm.

Male. Head thinly grayish pollinose, the orbits whitish, the front largely brownish; lower half of front and face with sparse whitish scales; hair coarse, black, rather dense; posterior orbits with pale tomentum and sparse black hairs; occiput with dense short black hair. Antennae black, wholly black haired, the terminal pencil of hairs strong.

Thorax with sparse white tomentum, the dorsum with black tomentum intermixed; and with coarse black hairs; pleura with white hair, the mesopleura with black hair intermixed; the black tomentum predominates on the basal half of the scutellum.

Legs black, the femora with some appressed luteous scales on basal half; front tibiae with strong spinules; anterior claws long; empodia absent.

Wings cinereous hyaline; with brown markings as follows; basal fifth of the wing except most of the alula, subcostal cell except apically and subbasally, anterior third of first basal cell on its basal half, a large spot at its middle which spreads backwards along the veins to join another spot at the posterior end of the second basal cell, and a large spot extending over the anterior crossvein and fork of the third vein; there is a grayish spot in the apex of the second basal cell anteriorly. Squamae white; supra-squamal tuft black; halteres reddish, the knob mostly brownish.

First abdominal segment thinly grey pollinose with scattered long black bristly hairs, broadly white pilose laterally except behind where there is a patch of long black pile. Second to fourth segments each with an incomplete median brownish yellow tomentose fascia, the second segment also with a narrow similarly colored basal fascia, the fasciae interrupted by white scales; second and third segments each with a large, transverse patch of white scales towards the sides posteriorly, the second to fourth each with a pair of median patches behind; fifth to seventh segments mostly white scaled, but there are some black scales medianly; all the scales are appressed. Abdomen with sparse, coarse long hairs, the sides of the abdomen with fairly dense black hairs on the basal half. Genitalia mostly reddish.

Female. Very similar but with much less white on the abdomen.

Holotype—♂, Seton Lake, Lillooet, B. C., June 15, 1926, (J. McDunnough); No. 2415 in the Canadian National Collection, Ottawa.

Allotype—♀, same data, June 7.

The genitalia show differences from those of *A. pauper.*

The following table separates the species of Anthrax (Spogostylum) represented in the Canadian National Collection.

1. Wings with deep brown markings ..... 2.
   Wings grayish with luteous tinge ..... *fur* O.S.
2. Wings with black spots in addition to the solid black patterns or with largely fused spots ..... 4.
   Wings with a solid blackish pattern ..... 3.

3. Alula wanting; marginal cell brown on whole length ..... *argyropyga* Wd.
Alula present; marginal cell broadly hyaline apically ..... *analis* Say.
4. Anal cell hyaline except sometimes the immediate base ..... 8.
Anal cell brown on basal half or with a brown spot near the middle .... 5.
5. Suprasquamal tuft black ..... 6.
Suprasquamal tuft white ..... 9.
6. Second anal cell without dark spots on apical half ..... 7.
Second anal cell with several dark spots on apical half .....*irrorata* Say.
7. No dark spot at end of sixth vein ..... *albofasciatum* Macq.
A large dark spot near end of sixth vein extending into anal and fourth posterior cells ..... *pluto* Wd.
8. Suprasquamal tuft white ..... *pauper* Lw.
Suprasquamal tuft black ..... *plesia* n. sp.
9. Costal cell checkered ..... *oedipus* F.
Costal cell brown except a small sub-basal pale spot ..... *simson* F.

ASILIDAE

Buckellia vitripennis n. sp.

In Melander's key to *Cophura* traces to couplet 7 where it fits neither alternative because of the black femora and pale yellow tibiae. Length, about 7 mm.

Male. Black, the hair wholly pale, with golden tinge. Head grayish pollinose, the face with yellowish tinge, the front brownish yellow; oral bristles; weak, hairs of face sparse, covering whole surface. Palpi black, with pale hair. Antennae black, the hair pale; third segment one and one fifth as long as basal two, the style scarcely longer than second antennal segment. Beard whitish, thin.

Thorax golden grayish pollinose, becoming more golden above, the mesonotum from anterior view with golden pollen and pile, from dorsal view with a large, sub-cordate blackish area extending across between the humeri and reaching to the posterior fifth of the dorsum; scutellum with the border broadly bare, with three pairs of weak marginal bristles.

Legs black; coxae gray pollinose and yellowish pilose; broad apices of femora reddish; tibiae except their apices, and the bases of the first two or three tarsal segments pale yellowish, almost yellowish white. Hair wholly pale golden yellowish.

Wings pale cinereous hyaline; veins black; fork of third vein slightly beyond apex of discal cell. Squamae and halteres whitish, the base of the latter brown.

Abdomen shining black, the sides broadly gray pollinose, the pollen strongly narrowed on the bases of the second to fifth segments so as to form triangles; sixth segment without pollen.

Holotype—♂, Seton Lake, Lillooet, B. C., June 3, 1926, (J. McDunnough); No. 2330 in the Canadian National Collection, Ottawa.

Laphystia Loew

In North America there has been a great deal of confusion regarding the identity of species in this genus. The real confusion has been due to the erroneous determination of *Dasypogon sexfasciatus* Say. The description given by Say should leave no doubt as to the identity of the species described by him since he

says that the abdomen is black: "tergum black, polished, each segment with a white band at tip, a little dilated in the middle, and occupying about one-third of its proper segment." This statement can apply only to the species which was described by Coquillett as *Laphystia flavipes*. The following table separates the Nearctic species.

1. Abdomen wholly black ..... 2.
   Broad posterior margins of apical five abdominal segments reddish yellow (N. Mex.) ..... *limatula* Coq.
2. Abdomen with entire pollinose fasciae on each segment or almost wholly pollinose ..... 3.
   Abdomen with most of the fasciae very broadly interrupted ..... 4.
3. Abdomen pollinose except basal spots on the sixth and seventh segments (Texas) ..... *opaca* Coq.
   Abdomen with six pollinose fascia, the seventh segment wholly pollinose ..... *sexfasciata* Say
4. Pollinose bands on first and second segments entire or practically so; femora and tibiae wholly reddish ..... *confusa* n. sp.
   All the pollinose bands broadly interrupted ..... 5.
5. Mesonotum with erect or sub-erect hair over the whole surface ..... *canadensis* n. sp.
   Mesonotum with erect hairs only in the middle and on the borders *notata* Bigot.

Laphystia sexfasciata Say.

Dasypogon sexfasciatus Say, Journ. Ac. Sci. Phila., iii, 50, 1823.
Laphystia flavipes Coq., Proc. Ent. Soc. Wash., vi, 180, 1904.

Previously recorded from Montana and North Carolina. The Canadian National Collection contains an excellent series from Aweme and Onah, Manitoba.

Laphystia notata Bigot.

Triclis notata Bigot, Ann. Soc. Ent. Fr., 433, 1878.
Laphystia sexfasciata Big., Bull. Soc. Ent. Fr., LXVIII, 1879.
Laphystia sexfasciata Auct., (not Say).

The Canadian National Collection contains four specimens from Brownsville, Texas, which are placed here. Since Bigot gave no locality for his species (except North America) it is not possible to place his species with certainty. There is a female from Douglas Co., Kansas, which may prove to be different since it has three or four rows of fine erect hairs along the middle of the mesonotum, while in the Texas specimens this hair is limited to the margins only.

Laphystia confusa n. sp.

Black; legs reddish, the broad apices of the tibiae and the tarsi wholly black, hair whitish, on the shining portions of the abdomen brownish or rusty reddish. Length 8.5 to 9.5 mm.

Male. Head argenteous white pollinose and white haired; bristles of antennae yellowish; antennal style very short and broad.

Thorax whitish pollinose, the mesonotum darker, with a broad geminate median and much broader, interrupted sub-lateral vittae of a brownish yellow or yellowish brown tinge. Hair of mesonotum very short and recumbent, rather golden, the borders, scutellum and pleura with erect fine white hair, the bristles yellowish. Lower surface and narrow free border of scutellum shining black.

Wings with slight brownish or gray tinge, the veins luteous; becoming brownish on apical half. First posterior cell broadly open, scarcely narrowed apically; border of squamae white; halteres yellow.

Abdomen shining black; first two segments except the very narrow posterior border of the second, an almost entire fascia on the posterior third of the third segment, very broadly interrupted fasciae on the following three, and the apical third of the seventh segment grayish white pollinose and whitish pilose; each segment with two to four short yellow bristles laterally. Venter wholly pollinose. Genitalia partly reddish. The sides of the abdomen are wholly broadly pale pollinose.

Type—♂, Wichita National Forest, Oklahoma, June 7, 1926, (W. J. Brown); No. 2363 in the Canadian National Collection, Ottawa.

Paratype—♂, Wyoming, July, 1905.

Laphystia canadensis n. sp.

Black, the legs partly reddish yellow; only the seventh and following segments with entire pale pollinose fasciae. Length 11 mm.

Male. Head wholly white pollinose and pilose; antennal bristles very pale yellowish, the style very broad, half as long as width of third antennal segment.

Thorax whitish pollinose, the dorsum with dull yellowish tinge, about half the hair erect and whitish, the appressed yellowish hair limited to the disc, rather sparse. Bristles very pale yellowish. Scutellum with six or eight long coarse marginal hairs. The mesonotum is obscurely pale vittate in some views.

Legs black; broad base of posterior femora, basal half of middle and one third of front and hind tibiae reddish yellow; legs pale grayish pollinose, the bristles all pale.

Wings cinereous hyaline; first posterior cell closed (usually short petiolate) or narrowly open. Squamal margin whitish; halteres yellow.

Abdomen shining black; entire sides of the abdomen and broad posterior border of the seventh segment gray pollinose, the pollen expanded to form projecting triangles on the posterior third of each segment, the triangles more whitish. Hair whitish on pollinose areas, elsewhere black. Venter wholly pale pollinose. Genitalia black.

Female. Hair on front of head with slightly yellowish tinge; base of middle femora and basal third of hind pair, reddish yellow.

Holotype—♂, *Allotype*—♀, Westbourne, Man., July 10, 1926, (G. S. Brooks); No. 364 in the Canadian National Collection, Ottawa.

Paratype—♀, Sioux City, Iowa, July 3, 1917, (C. N. Ainslie).

Promachus dimidiatus n. sp.

Length, 20 to 25 mm. Black in ground color, largely ochreous or brownish ochreous pollinose; legs dark rusty red, the femora marked with black, grey pollinose.

Male. Head ochreous pollinose, greyish on the occiput below; pile abundant, pale yellow, white on occiput (except the orbits) and cheeks; mystax without bristles; palpi black, with pale hair and only a few black bristles apically on upper surface. Antennae black, the first two segments sometimes reddish before the apex; third segment twice as long as wide, narrowly oval, somewhat tapering, almost one third longer than first segment; arista hardly twice as long as third seg-

ment. A few black occipital bristles above and some bristly black frontal hairs.

No dark thoracic vittae, but a pair of narrow median grayish or pale yellow vittae on anterior three-fourths and a broad, suturally interrupted one on either side; broad anterior and posterior, narrow lateral margins of mesonotum and the pleura, white haired, the hair of the mesonotum elsewhere sparse, short and black, becoming somewhat longer on pre-apical fourth; the black bristles are not numerous and extend only weakly in the dorso-central rows to the suture. Scutellum with long sparse white hair, the bristles mostly black.

Legs dark rusty reddish, grey pollinose, the tarsi darkened apically, the hair wholly white except on sides of posterior tarsi which also have black hairs mixed with the white on upper surface; the hair on the femora and tibiae is long on the ventral surface, on the tibiae sometimes with a few black hairs; bristles black. Anterior femora black anteriorly; middle pair black on lower half except apically, the posterior pair black except the upper half of posterior, whole dorsal surface and apex.

Wings a little tinged with yellowish brown, especially noticeable towards the apex. Squamae luteous with white fringe; halteres brown with reddish base.

Abdomen partly shining black on only the second, third and fourth segments; first two segments wholly white haired, or the second may have considerable black hair across the middle, the first with two or three black lateral bristles; third segment with a strong lateral patch of short hair on anterior half, usually extending completely across the segment and leaving only the anterior angles, sides, broad posterior triangles and more or less narrow posterior margin white haired; the fourth segment is frequently wholly white haired but there may be considerable black hair in the middle while the fifth segment rarely has more than a few black hairs; sixth and seventh segments usually with considerable black hair apically, the seventh and eighth often chiefly black haired. The genitalia are hidden from dorsal view by dense, soft, silvery while hair. In the dark forms the white hair forms more or less distinct posterior segmental fasciae. The sides, venter and the seventh and eighth tergites are cinnamon brown pollinose. Ninth sternite produced apically and downwards, with rather conspicuous black hair; forceps with only a few black hairs on apical half.

Female. Pollen everywhere slightly paler. Palpi sometimes almost all black haired. Only three or four pairs of black scutellar bristles, the others yellowish; abdomen wholly pale haired except rarely a median patch on third segment.

Holotype— ♂, *Allotype*— ♀, Aweme, Man., July, 1920, (E. Criddle), No. 2064 in the Canadian National Collection, Ottawa.

Paratypes— ♂, same data; ♂, ♀, Aweme, July 9, 1925, (S. Criddle); 4 ♂, 7 ♀, Aweme East, Man., July, 1920, (P. N. Vroom); 2 ♂, 4 ♀, Onah, Man., July 17, 1921, (Vroom); ♂, 2 ♀, Aweme, July 13, Aug. 25, 1907 (J. Fletcher); ♂, ♀, Victoria Beach, Man., July 14, 1923, July 20, 1924, (G. S. Brooks).

This species has been confused with *bastardi* Macq. but is much more greyish; the absence of black hair on the first abdominal segment of the ♂, and almost entire absence of black hair on the abdomen of the ♀ will at once distinguish *dimidiatus*. Superficially, the female looks like a grey form of *quadratus* Wied.

DOLICHOPODIDAE

Thinophilus russelli n. sp.

Dark greenish with yellowish brown and greyish pollen, the metallic ground color conspicuous on the mesonotum and abdomen. Length 2 mm.

Male. Head yellowish brown pollinose, the lower two thirds of the occiput grayish; palpi yellow with darker base, the pollen cinereous, the two or three coarse hairs yellow. Face moderately narrowed to the middle, the ground color scarcely evident above. About six black occipital cilia, the pile whitish. Proboscis black. Antennae yellow, the second segment brown on upper third, third segment sub-rectangular, the apex gently convex, brown on apical half, arista brown.

Mesonotum with yellowish brown or brown pollen, the notopleura and pleura densely gray pollinose; three or four bristly whitish hairs above the front coxae. Five dorsocentrals; two pair of scutellars.

Legs reddish yellow, the apical two or three tarsal segments brown, the basal segments somewhat darkened. Femora without soft hair, almost bare below, the hair wholly black. Front coxae with fine, short whitish hair, wholly yellow; posterior four coxae black, gray pollinose; posterior coxae with a single black bristle near the middle of the outer surface.

Wings cinereous hyaline, unspotted, the veins blackish; posterior crossvein twice its length from posterior border of wing. Squamal cilia short and fine, white. Halteres pale yellow.

Abdomen more or less bronzed above, with rather brownish pollen, the sides with grayish pollen which may form lateral subtriangular spots on the sides of the segments in some views. Genitalia small, the lamellae whitish, short and narrow.

Female. Face but little narrowed, the palpi usually whitish; tarsi more extensively pale; abdomen with the broad sides and apex grayish pollinose.

Holotype—♂, Nyarling River, N.W.T., July 4, 1926, (J. Russell); No. 2419 in the Canadian National Collection, Ottawa.

Allotype—♀, July 11, data otherwise the same.

Paratypes—6♀, July 4 and 11, the data otherwise similar.

This species is distinguished from *ochrifacies* V.D. by the wholly pale anterior coxae and from *canities* V.D. and *magnipalpus* V.D. by the brown pollinose face and front. The basal segment of the middle tarsus is shorter than the remaining segments.

SYRPHIDAE

Microdon hutchingsi n. sp.

Length, 12 mm. *Female*. Robust. Face half the width of the head, front distinctly narrowed above; face and front brownish red, the latter darker opposite the antennae and above, the pile brassy yellow; posterior ocelli remote; behind the ocelli three longitudinal broad densely punctured sulcae reach to the vertex. Third antennal joint longer than the first two combined, broad basally, slightly tapering, the end strongly upturned.

Thorax brownish black, with brassy yellow pile, the disc chiefly black pilose, the hair short. Scutellum large, deeply excavated apically leaving a large projection on either side.

Legs reddish yellow, the tibiae paler basally, the femora except their apices, sub-apical third of the tibiae and the hind basitarsi except apically, black.

Wings brownish, deeper brown on the anterior third and along the veins.

Abdomen brownish red, the base and margins darker; the pile greyish white.

Holotype— ♀, Queens Park, Aylmer, Que., August 10, 1922, (C. B. Hutchings); No. 704 in the Canadian National Collection, Ottawa.

This species differs from all others I have seen in the presence of three sulcae behind the ocelli, the allied species never having the median one present.

Helophilus stricklandi n. sp.

In the key by Curran and Fluke (Trans. Wis. Acad. Sci., xxii, pp. 211-12, 1926) traces to couplet 5 where it disagrees with both alternatives: if the color of the antennae is ignored it then traces to *groenlandicus* O. Fabr. and is related to that species. Differs from *groenlandicus* in having four narrow, gently biconcave gray pollinose fasciae on the abdomen, the first one being obscurely interrupted: in *groenlandicus* the fasciae are all broadly interrupted and pointed inwardly. Length 11.5 mm.

Female. Cheeks and median stripe on lower two thirds of face, shining black; head gray pollinose, the frontal pollen more brownish except laterally; pile pale cinereous; brown on upper half and median half of front below; the long hairs behind the eyes are brown. Face deeply concave on upper third, perpendicular below, moderately produced downwards. Antennae brown, the third segment brownish red; arista luteous.

Thorax black, pleura, broad lateral margins of mesonotum, posterior and anterior borders and a pair of narrow, posteriorly widening dorsal vittae, grayish, the vittae broadly interrupted in the middle by an opaque black spot. Scutellum brownish red. Pile fairly long, pale cinereous, with a tawny tinge dorsally; a few black hairs on mesopleura above.

Legs black; apices of femora, basal third of front and hind tibiae, middle tibiae except a broad preapical band and the first segment of the middle tarsi, reddish yellow. Front tarsi more or less brownish red basally.

Wings with slight brownish tinge; stigma brown, over twice as long as wide; squamae pale yellowish; halteres yellow.

Abdomen shining black, the second segment with a small reddish triangle on either side beneath the gray pollen; first segment thinly grayish pollinose; fascia on second segment strongly widened laterally, the others only slightly so. Second segment with an incomplete sub-opaque black, black-haired, fascia behind the gray one, the third and fourth segments each with a median, oval subopaque black spot and mostly black haired behind the gray bands except laterally; the pile elsewhere pale cinereous.

Holotype— ♀, Wabamun, Alberta, May 11, 1924, (E. H. Strickland); No. 2414 in the Canadian National Collection, Ottawa.

Parhelophilus brooksi n. sp.

Traces to *integer* Loew in the key by Curran and Fluke (Trans. Wisc. Ac. Sci., xxii, 231, 1926) but the abdomen has nearly parallel sides and the front is coarse, black pilose. Length 9 mm.

Male. Face reddish, a broad anterior stripe on the cheeks and broad oral margin in front, shining; head pollinose, the pollen grey on the lower three-fourths of the occiput and cheeks, whitish on the face, brownish ochreous on the occiput

above and on the front, although on the front above it is darker and has, in places, a grayish tinge. Pile yellow on occiput above, black on the front and whitish elsewhere. Front rather narrow, slightly widening behind; ocellar triangle large, but little wider than long, the outer ocelli situated far from the orbits. Face perpendicular, with a conspicuous concavity above, sometimes with a small, conspicuous tubercle near the middle. Antennae black, third segment and arista dark reddish, more or less broadly brown apically.

Thorax brownish ochreous pollinose, with three broad dark mesonotal vittae which are thinly greyish pollinose with brown margins, the median one divided on its anterior half by a slender gray line and narrowed on its posterior fourth. Pile pale yellowish or cinereous, reddish laterally. Scutellum translucent reddish, the narrow base and basal corners, black; pile wholly pale, long.

Legs reddish; posterior femora with a broad, apically tapering, incomplete black vitta above, the front and hind tibiae with a blackish preapical band on dorsal half, their tarsi with the apical four segments and the apical three of the middle pair, black, the first segment of the posterior tarsi brownish above. Hair of legs pale except on the posterior tarsi above and the short spinules on the apical half of the ventral surface of the posterior femora. Posterior femora about as large as in *obsoletus* Lw., but not at all arcuate.

Wings hyaline with all the veins conspicuously bordered with brownish yellow. Squamae white with yellow border. Halteres very pale yellowish.

Abdomen black, the lateral margins beyond the first segment and broad apex of the fourth, reddish. First segment mostly gray pollinose; broad sides of the remaining segments reddish yellow pollinose; second segment gray pollinose with a broad, incomplete basal fascia which is rectangularly produced in the middle to slightly behind the middle of the segment, opaque brown; third and fourth segments each with similar brown markings, although the basal band becomes successively shorter and more tapering laterally. On the third segment there is normally a pair of small ochreous pollinose spots contiguous with the median vitta, on the fourth these spots, when present, are in the shape of a rectangle connected in its full width with the lateral margins. The apex of the second segment is less thinly pollinose than elsewhere; the incomplete, very broad apices of the two following segments are shining black, while in specimens where the pollen is greatly reduced these segments may be all shining black except for the brown markings and broad sides.

Holotype—♂, Winnipegosis, Man., July 13, 1926, (G. S. Brooks); No. 631 in the Canadian National Collection, Ottawa.

Paratypes—♂, same data, in Mr. Brooks Collection, 6♂, Lake Dauphin, Man., July 16, 1926, (E. Criddle).

This peculiar species is certainly a *Parhelophilus* even though the abdomen is unusually narrow. It was taken around salty pools and will probably be found only in their vicinity. It seems strange that the species should come to hand immediately after the appearance of our paper dealing with the group.

EPHYDRIDAE

Caenia turbida n. sp.

Very similar to *C. bisetosa* Coq. but the lower ends of the fourth tergite are not strongly produced and shining on their inner edge. Length 4 mm.

Male. Metallic greenish, the color mostly obscured by brownish pollen. Face and cheeks silvery grayish, a brownish streak on the face above; front shining deep green in the middle, with a median vitta and the broad borders deep brown, from lateral view wholly brown. Palpi brown; antennae black.

Pleura with grayish pollen in front and behind; five dorsocentrals; one sternopleural.

Legs black, the femora greenish, brownish and grayish pollinose; posterior femora polished posteriorly, the hind tibiae polished on apical half of dorsal surface.

Wings with strong grayish tinge. Costal spine distinct, the costal bristles about one and one-half as long as the hairs, fine.

Abdomen with grayish pollen basally and on apical half of the third and fourth segments, elsewhere brownish, the pollen thin, leaving the abdomen rather polished. Each segment bears two or three fine marginal bristles towards either side.

Female. Quite similar; each abdominal segment except the first bears a row of very fine appressed marginals; genitalia with four contiguous spines in front.

Holotype—♂, Allotype—♀, Old Faithful, Yellowstone National Park, Wyo., Sept. 30, 1924, (N. Criddle); No. 2370 in the Canadian National Collection, Ottawa.

Paratypes—2♂, 1♀, same data.

The ♀ is separable from *bisetosa* by the shorter, finer costal bristles.

THE FERN-FEEDING SPECIES OF PAPAIPEMA; NO. 25 (LEPIDOPTERA).

BY HENRY BIRD,
Rye, N. Y.

That four species of *Papaipema, Papaipema stenoscelis* Dyar, *P. speciosissima* G. & R., *P. inquaesita* G. & R. and *P. pterisii* Bird, persist in making a food choice among the Cryptogams, those plants whose ancestry dates so far back in the floral phylum, might suggest that this quartet should show evidence of being the fore-runners of their generic complex. If, however, the inference is sustained that they are of Gortynid ancestry, as their larvae seem to indicate, this does not follow, and while they certainly occupy a niche by themselves, connecting through *pterisii* with the numerous yellowish section exemplified by *harrisii* Grt., they may be considered merely one of the individual groups evolved. One special and unusual feature with them is their type of ornamentation, the linear stigmatal marking, which proved a great help in running down the larvae of *stenoscelis* and *speciosissima*[1] when it was suspected from this stigmatal peculiarity that they too would prove fern feeders. And it would seem to further warrant the supposition that there need be no searching among the ferns in the effort to locate the larvae of those species where the early stages remain unknown, since none of these adults exhibit this peculiar detail of pattern.

In the matter of habitat their very occurrence is suggestive of certain ecological relations, particularly *stenoscelis*, whose food-plant flourishes only

1.—Can. Ent. vol. XLVII, p. 145, 1915.

under soil conditions of considerable, or even great, acidity. In mind, one at once associates this species with white cedar swamps, sphagnous bogs or modifications of former high acidity; also that the only other congener likely to be coexistant in its environmental community will be the Sarracenia-feeding *appassionata* Harv. The degree whereby *Papaipema* species cling to old haunts and undisturbed primitive conditions is proverbial. In this direction the fern feeders have chosen well as their various selections help in that they are notoriously persistant plants. *Inquaesita* in the rootstock of *Onoclea sensibilis* finds a plant claiming areas to itself, though its individual continuity may lapse as the connecting root system perishes at various points. To a lesser degree this seems to follow with *Anchistea* (*Woodwardia*) *viriginica,* tenanted by *stenoscelis;* the evidence that a large patch may be a single plant is more conclusive if the roots be examined, and doubtless such plant colonies persist over long periods. *Pterisii* in the common brake, feeds entirely in the lower portion of the stipe and does not get down to the rootstock, notwithstanding that its size and general condition would appear just as inviting as in either of the above mentioned instances. Its root growth seems even more rapid and when occurring in light or sandy soil, a very large area may be claimed by a single plant in a few years and doubtless such a growth may attain a considerable antiquity. But *speciosissima,* in Osmunda, has applied itself even better. When in the root of *O. cinnamomea* it is possible to associate with the most venerable individuals of our local flora. Some of these single roots at Rye are more than twelve feet across, nearly four meters, a great mass of interwoven root fiber and seem clearly by far the oldest living plant growths we have. Compared with the known growth examples have attained in thirty-five years, we estimate these great roots are fully three centuries old, quite out-distancing the oldest oaks or other local arboreal types. While such old roots are in no way necessary for *speciosissima,* it is recalled how the most thriving colony of which we know, that of the "Jersey Meadows," is flourishing for the most part in Osmunda clumps of great antiquity. So there are numerous details of individuality woven into the life history of this quartet, even from the cursory glimpses at hand. In general, we concede to having a satisfactory life history account if we know the ovum, larva, pupa and adult; the dates connected therewith, foodplant, distribution and so on. It is fine to have such information; for the two per cent that successfully mature and reproduce the species, it may be ample. But the ninety-eight per cent. which fall to eventualities, what of them? Are not their life happenings of major importance in the real economy of the species? Such of the *Papaipema* types as are stem-miners, and pupate in their galleries or larval chambers, offer an unusual retrospect of the pitfalls which operate against the unfortunates, for a registry of larval development is indicated in the plant growth so we may know at about when and how a check was met; if larval maturity was gained, an opening for the moth's exit will be made; the pupal remains show whether an adult successfully emerged, and the evidence of late parasitic attack is abundant. In all, a period of about three months becomes open to recapitulation. So, if a full list of the known course of eventualities has been worked out and familiarized, they may be checked with much certainty from evidences of the plant or the gallery contents, if an

examination be made shortly after the emergence date of the imago. Observations over many years to determine what befell a thousand individuals in the field, with certain easily followed species, show that there are about a dozen regular, primary fatalities brought about by causes which can be thus checked. They are mostly parasitic, some fungous disease or attachment, a few mammal attacks. At their peak, now and then some of these parasites decimate the host to thirty per cent or more of the observed happenings. Since it might be of value in applied matters, the following may offer some suggestive details showing how a natural balance seems worked out in a species having no economic import. Apparently an equilibrium is threatened if one, out of a dozen causes impinging on a species, attains a check amounting to thirty per cent. Imperfect as our conceptions of insect behavior may be, it is enlightening to note what befalls *pterisii* and a number of allied stem-feeders. Probably the most lethargic of all, this fern-feeder in its two months of mining, produces but an insignificant gallery wherein it is a ready prey to parasites. The following data is sifted from field and control observations covering many years.

About June 24, a small ichneumonid, *Microplitis gortynae* Riley, whose wing expanse is 6.5 mm., hatches from an overwintering puparium. Mating within a few hours, the gravid female sallies forth in search of a larval host, preferably *Papaipema*. Scent seemingly directs to a larval tunnel whose occupant at this date is fully one third grown. In its prying about the movements of the wasp are surprising deliberate, but with the spring which lands her on her victim, a violent struggle ensues, for the larva does not submit until exhausted and a secure position is only attained when the wasp gets located transversely at a suture fold of the mid-abdominal segments, where she holds on with true bull-dog tenacity. Oviposition takes about twenty minutes, a progeny of twenty to thirty usually result, and it is not known if there is further egg-laying. There is but one seasonal brood at Rye, N.Y. The host larva continues feeding, usually reaches penultimate stage and is yet living when the mature parasitic maggots bore out through its skin and spin up in a mass of tough, corrugated, grayish cocoons, partially encircling the host's body. This may occur August 2 to 30 and since these cocoon clusters remain in the host gallery until the following June before hatching, there is an extended period for secondary infestation, to which it would seem clearly the *Papaipema* host must ultimately owe its salvation.

Foremost in this counter balance is the chalcidid, *Eupteromalus viridescens* Walsh., somewhat smaller than its host and capable, apparently, of extending through three broods per season. If the *gortynae* are bull-dogs, the *viridescens* are wolves in numbers and pertinacity. May 10 finds them emerging, two, sometimes three from a single cocoon, and not rarely, every *Microplitis* puparium will have fallen to them. The females are ready to oviposit in twelve hours, and though known to be somewhat omnivorous, there is chance for seeking out other *Microplitis* cocoons which may have escaped the last season search. Under control, second broods reared from *gortynae* yet unscathed, emerge as adults in about forty-two days. These second broods were again ready to oviposit by the last of June and in the controls were observed inserting their ovipositors in the empty *Microplitis* cocoons and seemingly laying eggs therein. An alternative host will carry them over to the regular pupation stage of *gortynae*, in August,

although the adults may actually live this long. However, their adaptability is evident since occasionally, when no *Microplitis* cocoons are to be found in the *Papaipema* burrow and the central figure has pupated therein, the little *viridescens* are not deterred from ovipositing in the larger host, thus assuming a primary role. In lesser abundance as a hyper-parasite, *Gelis microplitidis* Gahan, emerges as an adult May 16 to 30, four or five examples from a *Microplitis* cocoon cluster being the usual infestation. With this species the female is wingless and ant-like in behavior; it is fully as large as its host and since it has been observed ovipositing Oct. 15, the assumption is that there may be at least two broods. In action, the ovipositor is directed downward into the host puparium, while the sheath remains immovably directed laterad. A lengthy seclusion seems to be sought in the central host's gallery, even though it may be long deserted.

Astomaspis fulvipes Grav. is met with even less frequently, and with *Hemiteles tenellus* Say, seem to represent rather chance happenings in the secondary parasitism of the *Microplitis* panorama. Emergence dates are in May for both, and they are near to their host in size.

Of the five above-mentioned species that emerge from these cocoon clusters, there was question in the beginning as to which was the real originator. It was settled by secluding a *Papaipema* larva as the parasitic maggots were boring through its skin, keeping their cocoons free from any outside attack and securing *M. gortynae* as the ultimate and only occupant. All the hyper-parasites get out through holes gnawed in the sides of the puparium; *gortynae* lifts off a round lid at the top, so it may be clear from these empty cocoon shells how the fates turned.

Several of the minute hymenopters also appear in the list of secondary parasites; a *Trichopria* of undetermined species and one other are positively of this category, and another undetermined one is probably so. They happen as single examples, seem but casual in the main following, and negligible in any real control of their host.

Mr. Gahan, of Washington, D. C., has provided the determination of these parasites.

Excepting the dipteron *Masicera senilis* Meig., we have little further data on primary parasites for the central host *pterisii*, since its pupal transformation is not in the gallery, but in the ground.

Hence it escapes reckoning with such a considerable number as make pupal attack solely. *M. gortynae* has never been noted as playing any part in the life cycles of the other fern-feeders. Each seems to have its individual retinue, and since they are root-miners, pupating in the soil, they are not easily observed. *M. senilis* may be expected to feature with all—it is the principal check with *speciosissima*, according to our data. *Inquaesita*, and particularly *stenoscelis*, experience a considerable hazard from drowning, for they are often entrapped in their root tunnels during the frequent floodings swampy areas are likely to undergo, and a serious mortality ensues. The latter has an undetermined *Apanteles* as a primary parasite which in occasional years reduces its host to an alarming minority. It pupates in a cluster of silken cocoons similar to the cluster of *Microplitis* in the matter of exposure, and there is likely a secondary following in its case.

Because the writer was at pains to assist with specimens of *Papaipema* at the time Hampson's Catalogue of the Phalaenae of the British Museum was appearing, it is felt clearness should be yet furthered by a statement relative to one of these fern species. In Volume IX, p. 78, under *pterisii*, Hampson describes an aberration as follows;

"Ab. 1. Fore wing with the upper part of claviform, orbicular, and points round reniform yellow." This refers to an unfresh specimen in the collection, from Massachusetts, which is really *P. purpurifascia* G. & R., according to authentic information, and the descriptive wording above substantiates this. It would be of small moment except that Strand's name *luteipicta*[2], proposed in lieu of this aberration number, might be accepted and thus misapplied. Names in the literature which refer to this fern feeder stand:

Papaipema pterisii Bird—1907,
Gortyna triorthia Dyar—1908,
Ab. *luteipicta* Strand— 1915. } =*P. purpurifascia*
Ab. 1 Hampson— 1910, } G. & R. —1868.

TWO NEW SPECIES OF EMPIDIDAE FROM ONTARIO (EMPIDIDAE, DIPT.).*

BY G. STUART WALLEY,
Ottawa, Ont.

While collecting in the vicinity of Niagara Falls, Ont., last summer, a new species of *Empis* was secured and a description is offered below. The species was quite common there during the latter part of June and specimens were found frequenting shady nooks in the rich moist woods of Niagara Glen.

The species of Rhamphomyia described below is represented by a large series of both sexes taken by Mr. N. K. Bigelow at Lake Abitibi, Ont.

Empis deterra n. sp.

Slender, yellowish species thinly coated with cinereous pollen, with few bristles and not at all hairy.

Male. Length, 8 mm. Front moderately narrow, black, slightly pollinose. Two basal antennal segments brownish; basal segment three times as long as the second; the second subglobose; the third bearing a style one third its length. Third segment and style black. All antennal segments with very short moderately dense yellowish pubescence when viewed obliquely. Proboscis yellowish brown, slightly longer than height of head. Occiput black with cinereous pollen and with two irregular rows of slender bristles. Ocellar triangle slightly elevated scarcely pollinose and bearing two slender bristles directed anteriorly.

Ground colour of thorax, yellow. Dorsum quadrivittate with brownish, the two middle vittae distinct, abbreviated posteriorly; the lateral vittae less distinct and extending forward only to the post-humeral region. Humeri, scutellum, metanotum, pleura, halteres and coxae yellowish with traces of fuscous on pleura, at base of coxae and on apex of metanotum. Entire thorax pollinose. Thorax bare except for a few scattered bristles. Pronotum with a sub-basal row of six or eight rather short black bristles. Humerus with two rather large and several weak

2.—Archiv fur Naturgeschichte, 1915, A., h. 11, p. 163.
*—Contribution from the Division of Systematic Entomology, Entomological Branch, Dept. of Agric., Ottawa, Ont.

bristles. One or two large bristles on notopleurum, supra-alar region and posterior callus; a few weak bristles along the margin of thorax and between the notal vittae. Scutellum with a pair of strong bristles slightly incurved situated one on either side midway between the median line and the lateral margin of scutellum. Wings with a brownish tinge; the furcation of the third vein takes place slightly before the end of the marginal cell, the posterior branch ending at the wing tip. Legs yellowish at bases, becoming brownish apically; tarsi brownish obscured with fuscous, darkest at the apices. Trochanters and tips of femora with the usual small black spot. Coxae with a few bristles mostly in front; the rest of legs with rather numerous sub-erect short bristles and with larger and more erect bristles on hind femora below near apices, also on mid and hind tibiae and tarsi except the last two tarsal segments where the bristles are short and blunt.

Abdomen yellowish with obscure traces of fuscous not as distinct bands or vittae. Tergites each with the apical margin rather heavily pollinose. Each tergite with a sub-apical row of slender bristles. Hypopygium with a loose cluster of rather long bristles below, and scattered somewhat tangled bristles above.

Female.—Differs only sexually from the male.

Holotype.—♂, Niagara Glen, Ont., June 24, 1926, (G. S. Walley); No. 2448 in the Canadian National Collection, Ottawa.

Allotype—♀, Niagara Glen, Ont., June 9, 1926, (G. S. Walley).

Paratypes—7♂, 8♀, same locality and collector as holotype, June 2 to July 1, 1926.

Rhamphomyia bigelowi n. sp.

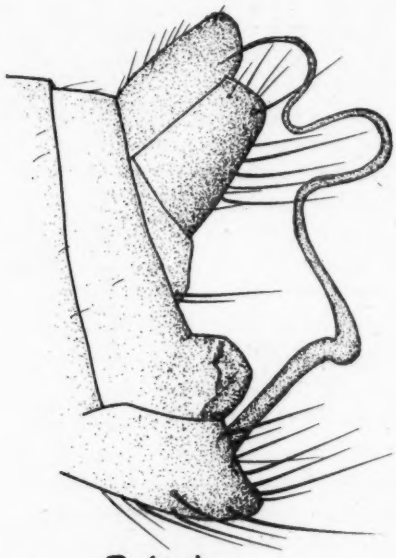
Agrees with Loew's description of *R. rustica* (Dipt. Am. Septent. Cent. V, 241, 1861) but with trivittate notum and the male with two rows of bristles on the mid femora, below.

Male. Length, 6.5 mm. Antennae with two basal segments yellowish, the remainder black. Style scarcely one third the length of the last segment. Eyes contiguous above antennae. Ground color of head black; pollinose except on oral margin which is shining black. Proboscis slender, as long as height of head. Occiput with two rows of black bristles.

Thorax black, greyish pollinose on sternum, coxae, pleura, scutellum, metanotum and notum between the three rather shining dorsal vittae of latter. Lateral vittae broader, slightly shorter in front and longer behind than middle vitta. Pronotum with a collar of several large bristles along the margin of notum; three or four on humerus and notopleurum, one supra-alar and one on posterior callus. Several weak bristles scattered along margin and on vittae. Posterior third of lateral vitta with three rather large bristles. Scutellar margin with four large bristles, the inner pair slightly longer and incurved so that they cross near tips. Halteres yellowish. Legs in mature specimens with ground color yellowish brown, trochanters, mid and hind coxae and hind tarsi, fuscous. Hind femora and tibiae, mid and front tarsi, piceous; remainder of legs yellowish brown. Leg bristles black; front and hind femora with a single row of weak bristles; mid femora with a row of closely set rather stout bristles which receive the tarsi when legs are folded; tibiae and tarsi clothed with numerous weak bristles and with scattered larger bristles;

femora with only fine pale pubescence visible when viewed obliquely. Wings yellowish brown, veins brown.

Abdomen shining; three basal tergites yellowish brown, the remainder piceous with paler incisures. Hypopygial filament fractured and very flexuous. (See figure).



R. bigelowi

Female. Eyes moderately widely separated. Basal abdominal segments piceous laterally. Legs darker than in male, the hind legs are almost wholly blackish in mature specimens; otherwise color and markings are as in the male.

Holotype. ♂ Lowbush, Lake Abitibi, Ont., July 27, 1925 (N. K. Bigelow). No. 2447 in Canadian National Collection, Ottawa.

Allotype.— ♀ same data as holotype.

Paratypes. 74 specimens of both sexes. Same locality and collector as holotype, July 17 to July 27, 1925.

Mailed Saturday, April 30th

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